

**U.S. HOUSE OF REPRESENTATIVES  
COMMITTEE ON SCIENCE**

**HEARING CHARTER**

**Nanotechnology Research and Development: The Biggest Little  
Thing in Texas**

Friday, December 5, 2003  
9:00 – 11:00 AM  
University of North Texas Research Park  
3940 Elm Street N., Denton, Texas 76203

**1. PURPOSE**

On Friday, December 5, 2003, at 9:00 a.m., the House Science Committee will hold a hearing to examine the emerging nanotechnology industry and the value of research and development programs to job creation and economic development within the U.S. nanotechnology sector.

**2. WITNESSES**

**Dr. Rick Reidy**, Professor of Materials Science and Engineering, University of North Texas. Dr. Reidy has a Ph.D. in Metals Science and Engineering from Penn State University and B.A. in Chemistry/Biochemistry from Rice University. Before joining the University of North Texas, he worked on nanoporous films for chemical weapons detection at the US Army Chemical and Biological Defense Command, Aberdeen, MD. He is currently developing nanostructured materials and processing methods for semiconductor applications supported by the National Science Foundation, Texas Instruments, and International Sematech.

**Dr. Da Hsuan Feng**, Vice President for Research and Graduate Education, University of Texas, Dallas. Dr. Feng has a doctorate degree in Theoretical Physics from the University of Minnesota. Since coming to UTD, he has worked to rapidly build the research breadth and depth of the University to make it a major international research university. Dr. Feng is responsible for recruiting much of UTD's nanoscience researchers.

**Dr. Ron Elsenbaumer**, Vice President for Research, University of Texas, Arlington. Dr. Elsenbaumer has a Ph.D. from Stanford University and a B.S. from Purdue University. His primary research interests include developing new conductive polymer compositions and developing quantitative group additivity principles for constructing conjugating conductive polymers with predictable optical, electrical, and electrochemical properties.

**Mr. Chris Gintz**, CEO, NanoHoldings LLC. Mr. Gintz is a well-known designer, marketer and executive in the computer industry, whose experience spans the semiconductor, software and hardware businesses. He is the inventor of the Compaq LTE notebook computer concept and,

since 1995, he has been a force behind the incorporation of software technology into school curriculums across the United States.

**Dr. John Randall**, Chief Technology Officer, Vice President of Research, Zyvex Corporation. Dr. Randall has a Ph.D. in Electrical Engineering from the University of Houston. He has over twenty years of experience in micro- and nanofabrication. He joined Zyvex in March of 2001 after fifteen years at Texas Instruments where he worked in high resolution processing for integrated circuits, MEMS, and quantum effect devices. Prior to working at TI, Dr. Randall worked at MIT's Lincoln Laboratory on ion beam and x-ray lithography.

### **3. OVERARCHING QUESTIONS**

The hearing will address the following overarching questions:

1. What is the state of nanotechnology science and engineering? What is the potential for nanotechnology advancements to contribute to future economic growth across various industries, and what challenges exist that may slow or limit this growth?
2. What is the status of private sector investment in nanotechnology research and development? How can the National Nanotechnology Initiative (NNI) and university-industry research partnerships best accelerate commercial applications of nanotechnology by industry?
3. Is the U.S. education system currently producing an adequate number of people with the skills needed to conduct research in nanotechnology and to work in industry on the commercialization of nanotechnology applications? What is the long-term outlook for the nanotechnology workforce, and what types of policies will help the U.S. education system to produce a workforce that meets these demands?

### **4. BRIEF OVERVIEW**

- Nanotechnology is the science of manipulating and characterizing matter at the atomic and molecular level. It is one of the most promising and exciting fields of science today, involving a multitude of science and engineering disciplines, with widespread applications in electronics, advanced materials, medicine, and information technology. For example, nanotechnology likely represents the future of information processing and storage, as computer chips and magnetic disk drive components will increasingly depend on nanotechnology innovations.
- The impact that nanotechnology is currently having on new and existing industries is significant, but the potential for the future is enormous. The National Science Foundation estimates that nanotechnology will have a one trillion dollar impact on the global economy in the next decade. Existing industries, including those not typically characterized as "high tech", are likely to see their product lines and the way they manufacture them influenced by our growing knowledge in nanotechnology.
- At a hearing before the House Science Committee in March 2003, witnesses testified that just five years ago, there was very little private interest in the nanotechnology research and development (R&D). Today, private investment is in the billions of dollars, with most Fortune 500 companies now funding at least some nanotechnology R&D, and venture

capitalists providing almost \$500 million to nanotechnology start-up companies in 2002 alone.

- The National Nanotechnology Initiative (NNI) is an \$849 million research initiative (fiscal year 2004 request) involving 10 federal agencies—and one of the President’s most significant new commitments to continued U.S. leadership in science and technology. The Science Committee has made nanotechnology R&D among its top priorities for 2003, working to strengthen the focus and funding of the NNI.
- On February 13, 2003, Chairman Sherwood Boehlert (R-NY) and Representative Mike Honda (D-CA) introduced H.R. 766, *The Nanotechnology Research and Development Act of 2003*, which authorizes a federal nanotechnology R&D program, thus assuring stable, long-term support. The bill also authorizes appropriations for nanotechnology R&D in those agencies within the Science Committee’s jurisdiction that currently participate in the NNI. A companion bill, S. 189, was introduced in the Senate by Senator George Allen (R-VA) and Senator Ron Wyden (D-OR). A final compromise of the two versions, *the 21st Century Nanotechnology Research and Development Act*, passed both chambers of Congress and is expected to be signed by the President very soon.
- The legislation supports the President’s initiative and adds review and oversight mechanisms to assure that new funds are used in the most effective manner possible. It also addresses a number of the recommendations that were raised in a comprehensive report by the National Academy of Sciences and other outside experts.

## **7. BACKGROUND**

A recent National Academy of Sciences report describes nanotechnology as the “...relatively new ability to manipulate and characterize matter at the level of single atoms and small groups of atoms...This capability has led to the astonishing discovery that clusters of small numbers of atoms or molecules often have properties—such as strength, electrical resistivity, electrical conductivity, and optical absorption—that are significantly different from the properties of the same matter at either the single-molecule scale or the bulk scale.” Scientists and engineers anticipate that nanotechnology will lead to “materials and systems with dramatic new properties relevant to virtually every sector of the economy, such as medicine, telecommunications, and computers, and to areas of national interest such as homeland security.”

A variety of nanotechnology products are already in development or on the market, including stain-resistant, wrinkle-free pants and ultraviolet-light blocking sunscreens. Other applications involve Kodak’s use of scratch-free, transparent coatings and Samsung’s new high-brightness displays. Experts agree that more revolutionary products will emerge from nanotechnology research currently underway. Many small start-up companies have been founded to develop new technologies and new products based on breakthroughs in our understanding of materials at the atomic and molecular level.

### **The National Nanotechnology Initiative**

The National Nanotechnology Initiative (NNI), formally established in 2001, is the President’s most ambitious interagency interdisciplinary science and technology program. Ten federal agencies actively participate in research and development efforts that involve physicists, chemists, biologists, engineers, and researchers from many other disciplines. The initiative has

grown rapidly from an initial budget request of \$464 million in fiscal year 2001 to the \$849 million requested for fiscal year 2004 (although these numbers are not strictly comparable as some ongoing research programs have, over time, evolved into nanotechnology research).

While each agency involved in the NNI focuses its research on that agency's unique mission, the overall effort is organized at the White House level through the articulation of Grand Challenges—or broad, mission-related, technical goals. These include nanotechnology-based innovations in manufacturing, energy production and storage, information technology, medicine, robotics, aeronautics, and defense and homeland security applications.

Recognizing the inherently interdisciplinary nature of nanotechnology science and engineering, the NNI supports research through nanotechnology centers and user facilities, designed to bring researchers from multiple disciplines together, as well as through grants to individual researchers and groups of researchers. The National Science Foundation (NSF), the Department of Energy, and the National Aeronautics and Space Administration (NASA) currently sponsor, or are in the process of establishing, a number of nanotechnology research centers and user facilities around the country. Among the NSF-supported centers, some are focused on specific industries, such as the Center for Nanoscale Systems in Information Technologies at Cornell University. Others are national user facilities, such as the nanofabrication facilities at Stanford University and Pennsylvania State University, and one, the Center on Biological and Environmental Nanotechnology at Rice University, conducts research on the societal implications of nanotechnology development.

The overall federal effort is coordinated by the National Science and Technology Council's (White House coordinating council composed of the heads of the major research agencies) Subcommittee on Nanoscale Science, Engineering and Technology (NSET), which has responsibility for interagency planning and review. While each agency consults with the NSET Subcommittee, the agency retains control over how resources are allocated against its proposed NNI plan. Each agency then uses its own methods for inviting and evaluating research proposals.

Table 1. National Nanotechnology Initiative Funding (\$\$ Millions)

<b>NNI AGENCY</b>	<b>FY 2001 Enacted</b>	<b>FY 2002 Enacted</b>	<b>FY 2003 Enacted</b>	<b>FY 2004 Requested</b>
NSF	150	199	221	249
DOD	123	180	243	222
DOE	88	91	133	197
NIH	40	41	65	70
DOC	33	38	69	62
NASA	22	46	33	31
USDA	2	2	1	10
EPA	5	--	6	5
DHS (FAA/TSA)	--	2	2	2
DOJ	1	1	1	1
<b>TOTAL</b>	<b>464</b>	<b>600</b>	<b>774</b>	<b>849</b>

Acronyms: NSF—National Science Foundation; DOD—Department of Defense; DOE—Department of Energy; NIH—National Institutes of Health; DOC—Department of Commerce; NASA—National Aeronautics and Space Administration; USDA—U.S. Department of Agriculture; EPA—Environmental Protection Agency; DHS—Department of Homeland Security; DOJ—Department of Justice.

## **The 21st Century Nanotechnology Research and Development Act**

This legislation, a House-Senate compromise of H.R. 766 and S. 189, would cement U.S. economic and technical leadership in nanotechnology by assuring stable, long-term support for nanotechnology research and facilitating the commercialization of nanotechnology applications. The bill establishes an interagency research and development (R&D) program to promote and coordinate Federal support of nanotechnology R&D, including grants to researchers and the establishment of interdisciplinary research centers and advanced technology user facilities. The bill also emphasizes the need to perform research into the ethical, legal, environmental, and other appropriate societal concerns related to nanotechnology, to educate the public about nanotechnology, and to involve the public in the debate. The bill aims to protect taxpayers by adding oversight mechanisms—an interagency committee to coordinate the program across multiple agencies, an annual report to Congress, a strategic plan for the program, an advisory panel, and external reviews—to assure funds are spent wisely. The bill authorizes approximately \$3.7 billion of funding at five agencies over four years.

Table 2. Nanotechnology Funding History and Funding Authorized by H.R. 766

<i><b>AGENCY</b></i>	<b>FY 2001 Enacted</b>	<b>FY 2002 Enacted</b>	<b>FY 2003 Enacted</b>	<b>FY 2004 Requested</b>	<b>H.R. 766 FY04</b>	<b>H.R. 766 FY05</b>	<b>H.R. 766 FY06</b>
NSF	150	199	221	249	<b>350</b>	<b>385</b>	<b>424</b>
DOE	88	91	133	197	<b>265</b>	<b>292</b>	<b>322</b>
NIST	33	38	69	62	<b>62</b>	<b>68</b>	<b>75</b>
NASA	22	46	33	31	<b>31</b>	<b>34</b>	<b>37</b>
EPA	5	--	6	5	<b>5</b>	<b>5.5</b>	<b>6</b>
<b><i>TOTAL</i></b>	<b>298</b>	<b>382</b>	<b>462</b>	<b>544</b>	<b>713</b>	<b>784.5</b>	<b>864</b>

Note: While H.R. 766 authorizes into law a national nanotechnology R&D program to include all participating agencies as designated by the President, appropriations are authorized only for those agencies within the jurisdiction of the Science Committee.

## **8. WITNESS QUESTIONS**

Questions for university witnesses:

- How significant of an impact will nanotechnology have on U.S. economic growth and job creation in the coming decades? In what industry areas will the impact be most dramatic? What challenges exist that may slow or limit the growth and influence of nanotechnology?
- What in your experience are the best practices to help facilitate the transfer of basic research results to industry? To what extent has your university partnered with industry on nanotechnology research and development challenges, and how can such collaborations be made more effective?

- Has federal support for your research been effective at helping your university achieve its goals? How might Congress strengthen the structure, funding levels, and focus of the National Nanotechnology Initiative?
- Is the U.S. education system currently producing an adequate number of people with the skills needed to conduct research in nanotechnology and to work in industry on the commercialization of nanotechnology applications? What is the longer-term outlook for the nanotechnology workforce, and what changes, if any, should be made to the current education system to ensure these workforce needs are met?

Questions for industry witnesses:

- How significant of an impact will nanotechnology have on U.S. economic growth and job creation in the coming decades? How will nanotechnology influence the industry areas in which your company is most active? What challenges exist that may slow or limit the growth and influence of nanotechnology?
- What is the appropriate federal role in fostering and accelerating the deployment and application of basic nanotechnology research and development by the private sector? How might Congress strengthen the structure, funding levels, and focus of the National Nanotechnology Initiative?
- To what extent is your company involved in research collaborations with universities, and how can such collaborations be made more effective?
- Is the U.S. education system currently producing an adequate number of people with the skills needed to conduct research in nanotechnology and to work in industry on the commercialization of nanotechnology applications? What is the longer-term outlook for the nanotechnology workforce, and what changes, if any, should be made to the current education system to ensure these workforce needs are met?